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Steel - U.S. Steel

A Report on Accomplishment

FOUR MAJOR ADVANCES IN SAFEGUARDING WATER QUALITY

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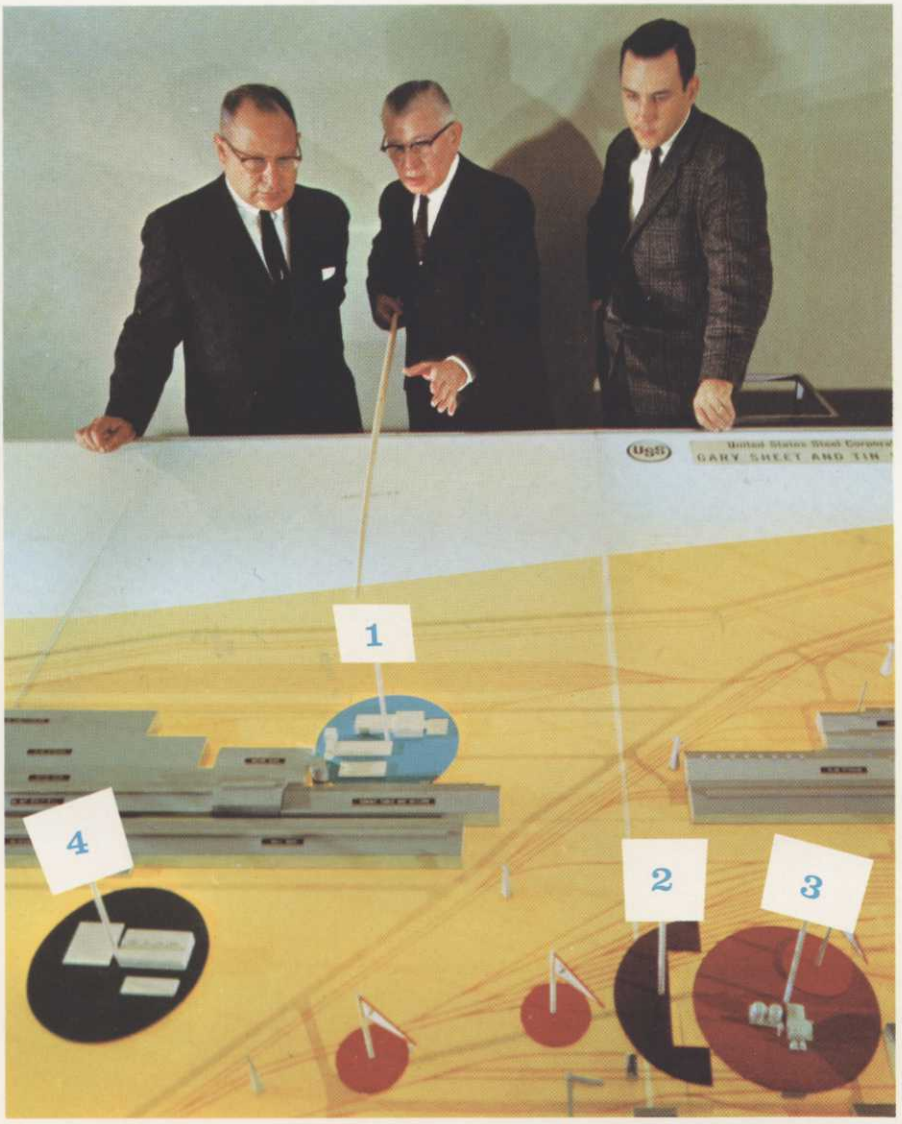
Gary Sheet and Tin Works
United States Steel



Twenty acres of Gary Sheet & Tin Works are occupied by four new conservation systems. General Superintendent Theodore J. Koenig locates the water quality safeguards on a scale model of the U. S. Steel plant for Murray Stein (left), Assistant Commissioner of the Federal Water Pollution Control Administration, and Sam Moore, representative of the Indiana Stream Pollution Control Board.

THE COVER PHOTO shows the new flocculator-clarifier at Gary Sheet and Tin Works that is designed to remove emulsified oils from the process water. The men engaged in its operation are: Millwright Arthur Craig (center), Maintenance Foreman Frank Moran (left foreground) and Foreman Norman Graden (right foreground).

GARY SHEET AND TIN STRIDES FORWARD IN WATER CONSERVATION.

Four major water conservation systems are coming into operation at Gary Sheet and Tin Works. These systems hold particular significance for our community neighbors and, in my opinion, will be of interest to anyone having responsibility for water quality.

The first system employs three basins and related equipment to contain the effluent water from a new 84-inch hot strip mill long enough to settle out scale and skim off surface oil. Filters then treat the scale pit effluent by a method similar to that used in city systems for the final clarification of drinking water.

The second system disposes of spent acids from the pickling lines by thrusting them 4300 feet underground where they are permanently isolated from ground and surface water, while the third permanently neutralizes several acid and caustic wastes.

Emulsified oils which refuse to settle out of the water are the target of the fourth system. This new water quality control employs gravity separation, polyelectrolyte treatment, chemical agglomeration, and centrifuging in removing these oily wastes from the mill effluent.

Close coordination with Mr. B. A. Poole, Technical Secretary and Chief Engineer of Indiana's Stream Pollution Control Board, and his staff, enabled us to proceed – from design to finished plant – with the Board's approval.

The water conservation history of Gary Sheet & Tin Works reflects the participation of U.S. Steel in the economic growth of the Gary-Chicago area.

The first scale pit at Gary Sheet & Tin was dug in the Indiana Dunes in 1911. A major water conservation project for those times, Pit No. 1 was more than adequate to handle its assignment. It measured 12 feet by 12 feet. Today, just one of the new scale pits is 120 times the size of the original.

All of us are proud of these latest advances in water quality control, and we welcome the opportunity to tell you how we are carrying out our role in protecting a resource that we share with more than six million other people who live and work along Lake Michigan's shore.

THEODORE J. KOENIG

T. J. Koenig

General Superintendent

Gary, Indiana
March, 1968

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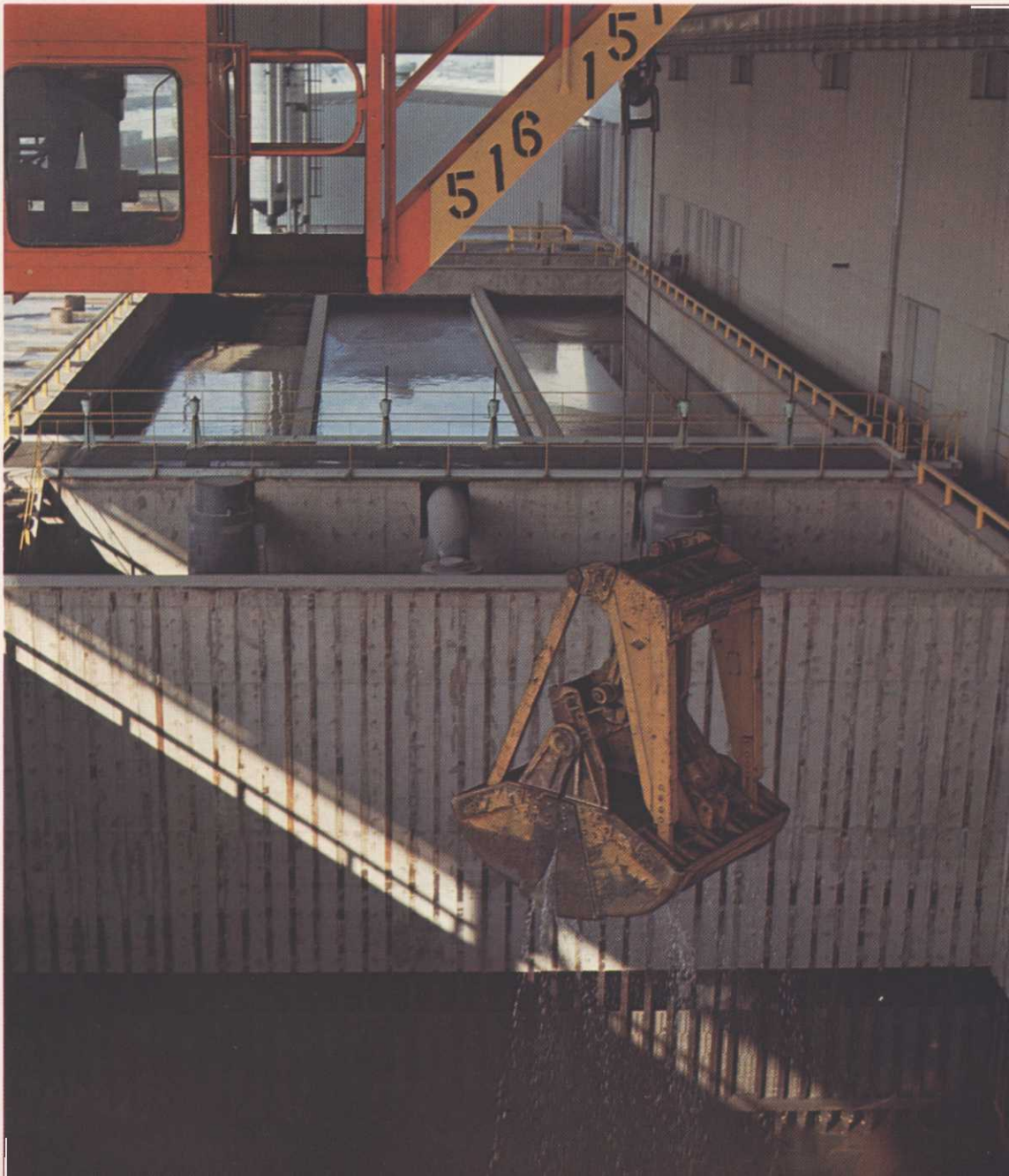
WATER QUALITY PROTECTED ON THE NEW 84-INCH HOT STRIP MILL

A hot steel slab measuring 40 feet long and 10 inches thick enters the roughing stands of the new 84-inch mill, flattens down to 1/20 inch thickness under the finishing rolls and completes its one-minute trip through the mill as a coiled ribbon of steel a mile in length.

Scale forming on the slab as it is reheated to rolling temperature is the principal waste generated on this new mill. Blasted loose by high pressure water sprays during the rolling process, the scale is sluiced away to the scale pits for removal.

Another waste results from the use of 14 different lubricants required to operate this facility. Oily wastes are kept to a minimum by the use of self-lubricating equipment wherever possible. Inevitably, there is some loss, however, and these "tramp oils" are sluiced with the scale to three scale pits.



Craneman Ted Kolodzinski lowers clam-shell bucket into the roughing section scale pit for a 3-ton grab of coarse scale chunks, knocked off the hot slabs on the first, or roughing stands of the 84-inch mill. This huge basin, covering an area two-thirds that of a football field, holds the effluent water in its first section long enough for the big scale pieces – some as large as a playing card – to settle to the bottom.

Step Two in Removal of Scale

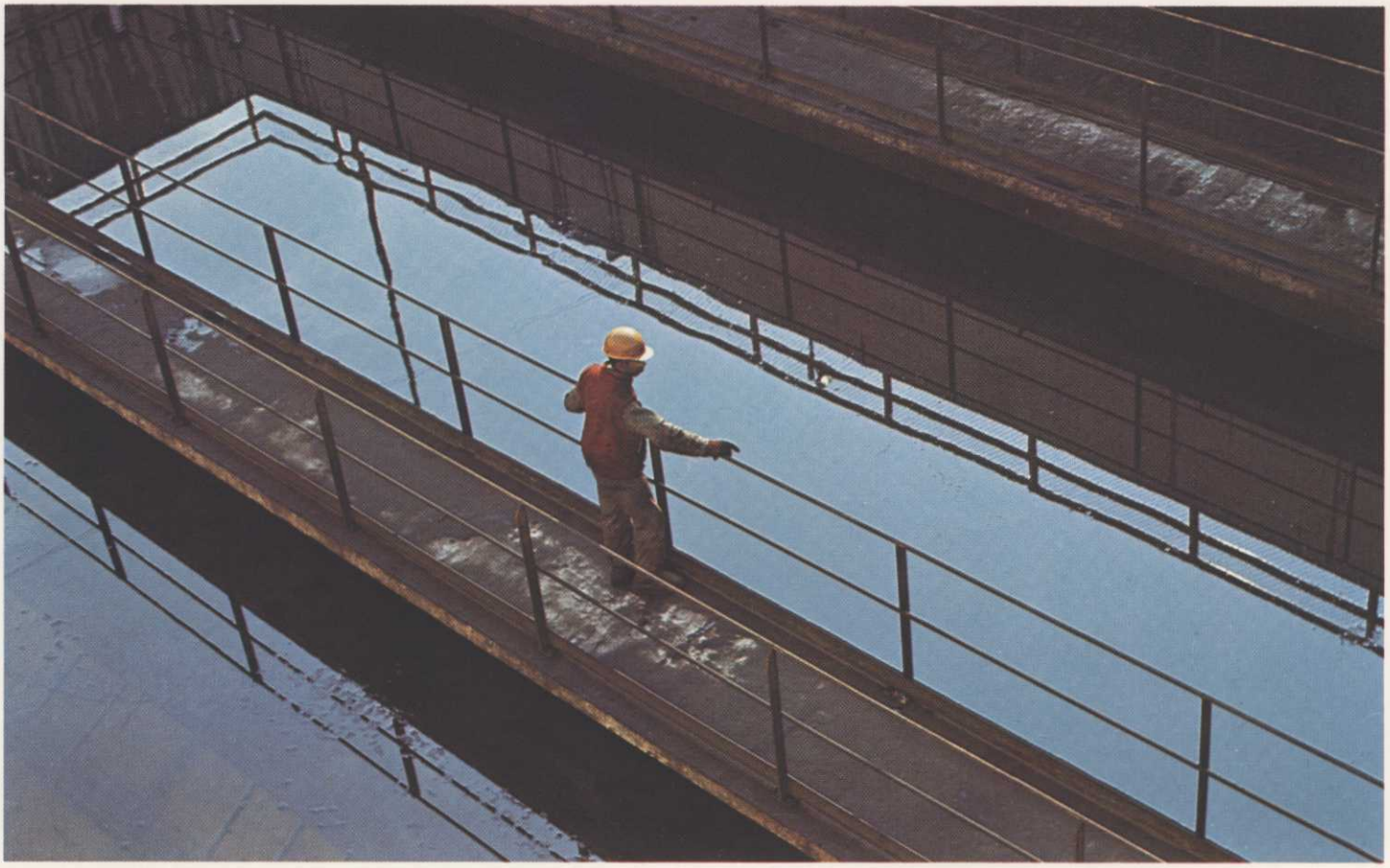
Rid of its heaviest burden, the roughing section effluent flows from the first pit to the wet well and is pumped to the three secondary pits, beyond, where the smaller scale settles out.

Engineer John Hershberger and Technician Don Potrebic check intake gates to the secondary pits.

Waste collected ahead of the skimmers on the run-out table scale pit and clear effluent water supply a vivid "before-and-after" illustration of results achieved by the scale pits in water quality control. Millwrights Howard Stacey and Bill Parish identify effluent sample for tests.

Clear water, stripped of pollutants, cascades from the run-out pit.

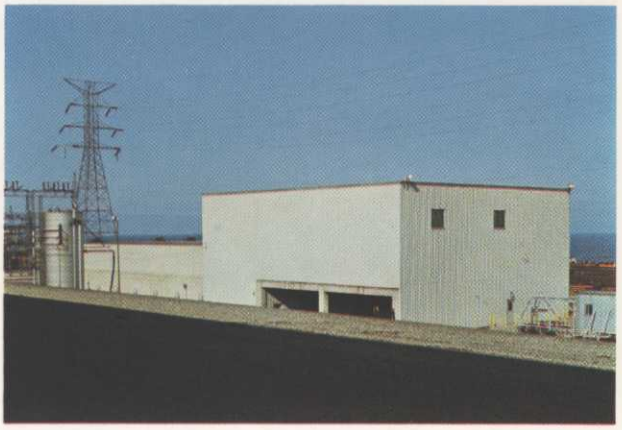
Technician Lynn Haines tests the effluent for Ph (degree of alkalinity or acidity).



This basin entraps scale knocked off the steel in the finishing stands. As the steel progresses from the roughing section through the finishing section, the scale becomes increasingly fine – until, at the last two stands, the particles are smaller than a micron (39 one-millionths of an inch). The equipment includes scrapers which move continously along the bottom of the basin to remove the settled scale.

Like the roughing section and run-out table scale pits, the finishing section scale pit collects waste oils as well as scale.

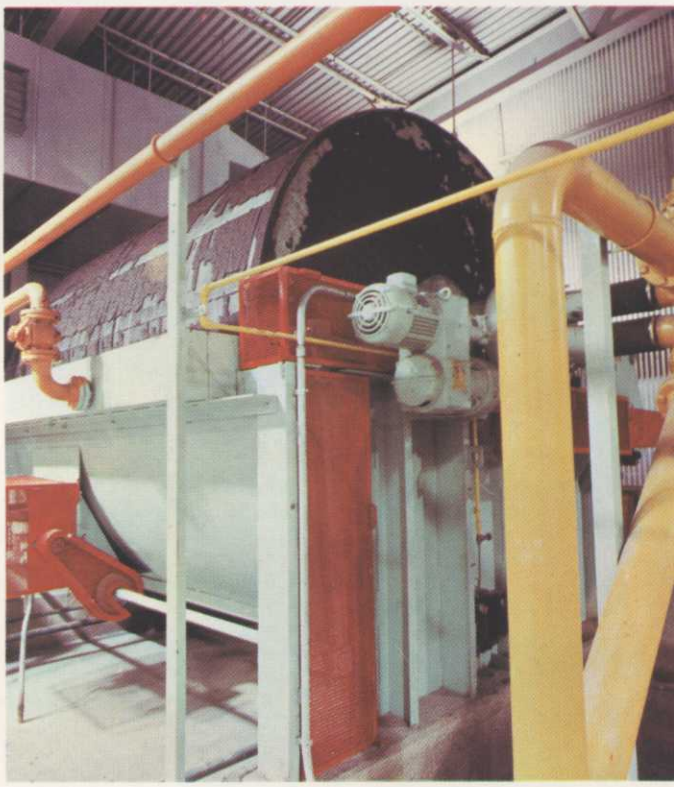
George Williams, the man in the photo, keeps the oil skimmers adjusted to high operating efficiency.



The finishing section scale pit all but completes the job of removing scale from 84-inch mill effluent water – all but removal of the submicron particles. This final treatment assignment falls to the high-rate filtering process housed in the building above.

This filter contains 93 tons of stratified anthracite coal, sand, gravel and stone. It is one of 12 that apply a method similar to that used in the final clarification of drinking water to the effluent from the finishing section scale pit. Observing the filtration process is James H. Dickerson, superintendent of utilities.

The backwash water containing the concentrated sub-micron scale is drawn from the filter surface to a thickener. The particles of scale settling to the bottom are pumped to two vacuum filters where they are removed for disposal. Effluent water is sent back into the settling basin for reprocessing.



Vacuum filter (right) creates "cake" of sub-micron particles, dewatered by vacuum pumping through the filter medium on the surface of the revolving drum. The caked particles are removed by a scraper, and conveyed on a continuous belt to a storage area for removal.

Thus ends the turbulent trip of the sub-micron scale particle. Starting on its way from the finishing section, coursing unimpeded through the scale pit, then caught in the sand filter and thickened in the clarifier, the elusive speck of iron oxide finally emerges on dry land in the form of filter cake.

2

DEEP WELL ISOLATES PICKLING WASTES

66-inch Pickling Line

"Pickling" in steel mill language refers to the immersion in dilute sulfuric or hydrochloric acid solution by which steel rids itself of the oxide film which has formed during the heating, rolling, and cooling process. Reaction between acid and scale gradually reduces the strength of the pickle solution, and ultimate disposal of the weakened pickle liquor presents one of the steel industry's most difficult waste problems.

Process change has alleviated that problem: the volume of this stubborn waste has been reduced by temper rolling the steel to reduce pickling time.

After findings by geologists revealed that deep well injection to the Mt. Simon Strata underlying Northern Indiana would not affect ground or surface water, this method has been installed at Gary Sheet & Tin Works.

One of the processes "spent" pickle liquor must undergo prior to deep well injection is filtering out specks that could slow its flow into the porous rock in the Mt. Simon Strata.

Technician Joseph Toth at the control panel monitors the spent pickle liquor flow through the filter tanks to the left.

Utility operator Terry Niloff regulates discharge valve on one of the two holding tanks which assure efficient flow of spent liquor into the well. The pipes ringing the tanks are part of a steam heating system which prevents crystallization of sulfate salts by maintaining a temperature of 90 degrees.

Deep, Deep, Well 4,300 Feet Down

Stationed at the well head, Thomas Chelf, waste treatment foreman, holds in his right hand a core sample of the shale encountered 2095 feet below surface, and, in his left, a sample of the Mt. Simon rock, which the spent pickle liquor permeates, twice as far underground. The Mt. Simon Strata is permeable to the equivalent of 14 per cent of its volume.

Made of fiberglass reinforced tubing to reduce acid reaction, the well tube is surrounded by a sleeve, or annulus, of water encased in steel pipe to provide necessary strength.

The annulus water, introduced under pressure at the top, provides additional protection against acid leaks by equalizing pressures outside and inside the well tube.

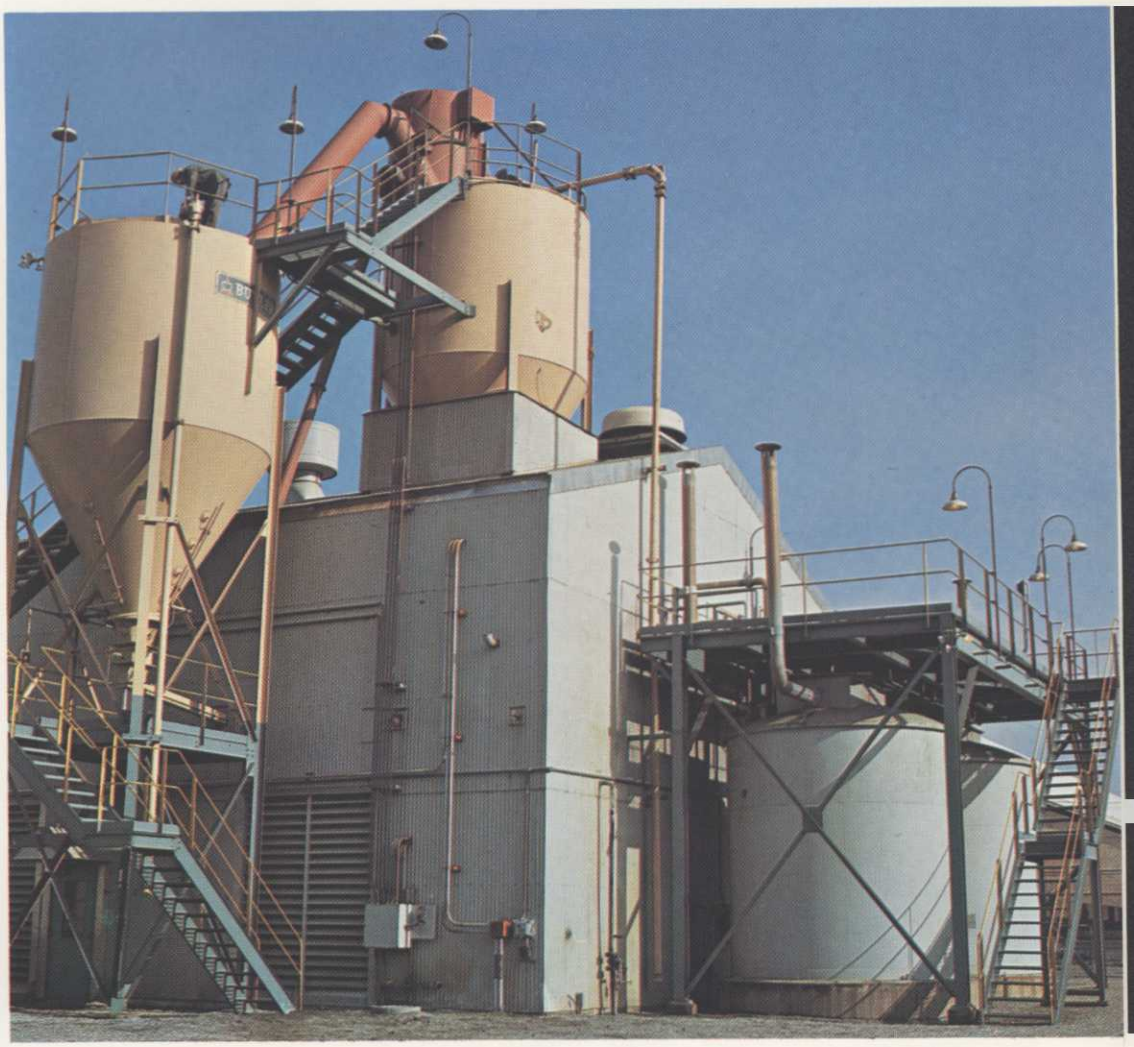
No. 6 Tinning Line

3

NEW TREATMENT FOR CHEMICAL WASTE

The new chemical waste treatment plant exemplifies the use of waste segregation to improve control efficiency. Acid and caustic wastes from No. 5 and No. 6 tinning lines, and nitric hydrofluoric acid wastes from the stainless steel pickle line are neutralized. The different acid wastes generated in these processes have one common characteristic. All of them are effectively treated by lime neutralization. The caustic wastes, as they undergo treatment, also serve as an additional neutralizing agent in the reactor tanks.

The acid neutralization structure occupies a site adjacent to the deep injection well. Two outside feeder bins introduce lime into two mixing tanks inside the structure. Motor driven paddles mix the lime with water to form a slurry which serves as the neutralizing agent.



In the waste acid treatment plant, technician Robert Striker monitors automatic control board which registers the flow of acid and caustic wastes to the reactor tanks. Neutralization takes place in the reactor tanks, located at the right of the neutralization building, where the tinning and stainless pickling wastes mix with the lime slurry. Here the caustic wastes from the tinning lines make their contribution to the neutralization process.

Six-stand Cold Reduction Mill

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TERMINAL TREATMENT REMOVES EMULSIFIED OILS FROM PROCESS WATER

Cold rolling oils, serving as both lubricant and coolant in reducing the thickness of steel from hot strip mill gauges down to sheet gauges, present an entirely different problem. These emulsified oils are only partially separable by gravity and require chemical treatment to break the emulsion before the oil can be removed.

Engineer Howard Gilles (above) inspects primary separators at the terminal treatment plant. The wastes flow from the new six-stand cold reduction mill, No. 7 cleaning line and the three-stand, four-stand, and west five-stand cold reduction mills.

Suspended solids settling to the bottom of each separator are removed by continuous scrapers and deposited in two settling tanks inside the building for further treatment.

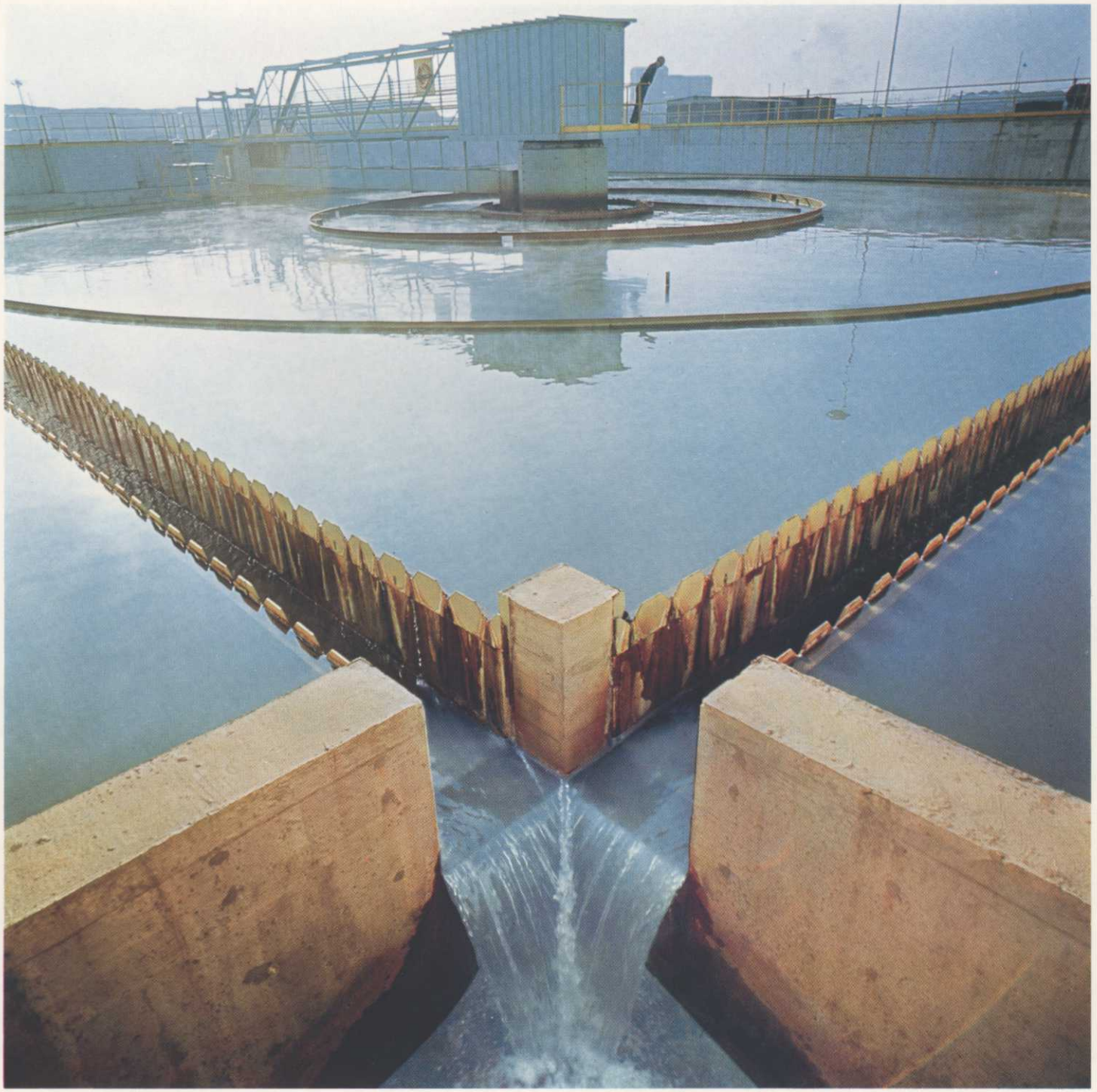
The continuous skimmers dip into the floating oils at the intake end of the separator and skim them toward the effluent end where a screw conveyor carries them to an oil sump. The oils are then pumped to concentration tanks.

The effluent emulsion from the primary separators flows to two mixing tanks.

Two coagulating agents, pickle liquor and lime slurry, mix with the wastes in the first tank. Thus, two per cent of the plant's waste pickle liquor output is diverted from deep well injection to serve as an aid in waste control.

In the second tank, polyelectrolytes, which cause the suspended oils to form a stringy substance, are mixed in the solution.

Emulsified Oils Drop Out Here



The emulsified waste cold rolling oils make their departure from the cold rolling effluent by agglomeration, sedimentation, concentration and surface skimming in this flocculator-clarifier.

The intake from the mixing tanks enters the center of the flocculator-clarifier where the combined actions of the pickle liquor, polyelectrolyte and lime slurry on the emulsified oil are hastened by stirring with vertical paddles.

The flocculated waste flows at a uniform rate to the outer clarification compartment where sedimentation occurs.

Surface oil is collected by a revolving collector, beached on surface "run out" boxes and pumped to oil concentration tanks for disposal. Bottom rakes collect the material at the bottom, where pumps move it to centrifuges for dewatering. This clear water is the end result of the flocculator-clarifier process.

WATER CONSERVATION PROCESSES

Waste treatment at Gary Sheet & Tin Works employs six basic processes in separating pollutants from the effluent water.

Settling.

Solids drop out of the water when it is contained in the scale pits, the filter plant thickener in the 84-inch mill, and the separator basins and flocculator-clarifier at the terminal treatment plant.

Flocculation

is a process employed to gather particles into larger – and more readily removable – flakes. It is one of the methods employed in the terminal treatment plant's flocculator-clarifier.

Skimming,

the gathering of floating oils, is the function of the arms rotating on the surface of the flocculator-clarifier. The roughing stands scale pit, the finishing stands scale pit, and run-out table pit serving the 84-inch hot strip mill also have oil skimmers.

Chemical Treatment

uses lime mixed in water to neutralize tinning line acids and stainless steel pickling acids in the acid neutralization plant. In two instances of chemical treatment, the wastes themselves serve as treating agents. Waste pickle liquor is used in treating emulsified cold rolling oils in the terminal treatment plant, and caustic wastes are used for acid treatment in the acid neutralization plant.

Polyelectrolytes facilitate the removal of waste particles from the effluent water by attracting them into a stringy form. This method is utilized in the filter plant and the terminal treatment plant.

Filtering,

through deep sand beds by gravity and by vacuum through a cloth filter medium, removes fine scale in the 84-inch hot strip mill process water. Waste pickle liquor is filtered through leaves of polyethelyne prior to deep well injection.

Deep Well Injection

thrusts spent acid solutions far below the lowest level at which potable water exists.

NEW SYSTEMS EXPAND TREATMENT NETWORK

The new flocculators, clarifiers, filters and settling basins described in this brochure join an established network of water conservation facilities located on this scale model of Gary Sheet and Tin Works.

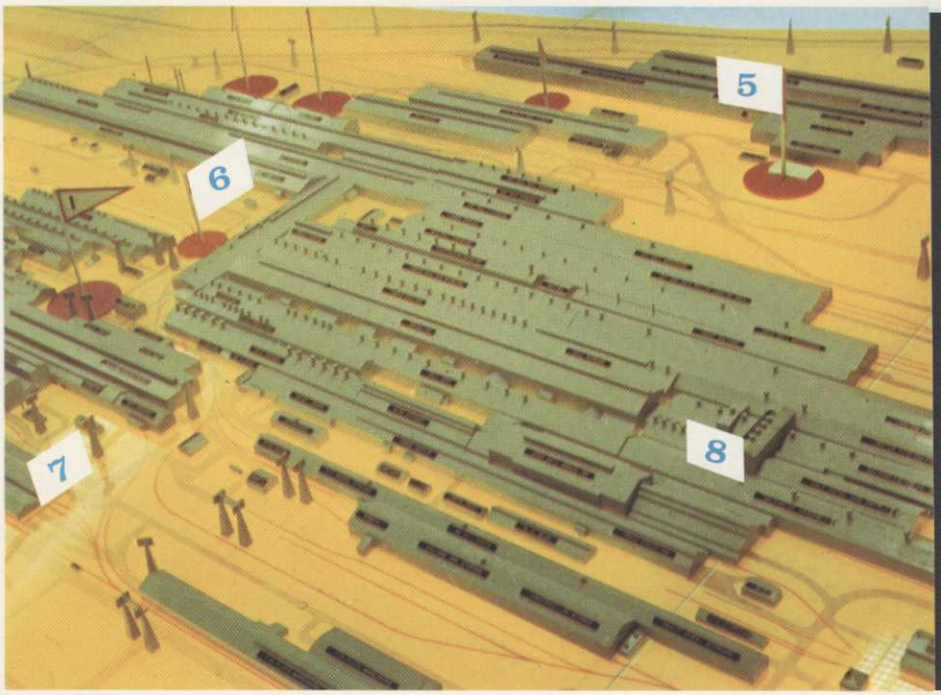
Its major components are:

5 Waste treatment facilities serving the 80-inch five-stand cold reduction mill.

6 Roughing section and finishing section scale pits on 80-inch hot strip mill.

7 Settling basins.

8 Collecting stations which receive all of the plant sanitary wastes and pump them to Gary's municipal system for treatment.



Terminal Treatment Engineer Keeps an Eye on the Future

One of the important aspects of the water quality safeguards just described is space. Twenty acres were necessary for containment capacity sufficient to permit pollutants to drop out or be extracted from the process water.

In providing for this capacity, Gary Sheet & Tin engineers are keeping an eye on the future. At the terminal treatment plant, for example, plans are under way for two additional flocculator-clarifiers to meet treatment requirements of the future.

Vern Frank who has the engineering responsibility for the new treatment facilities, is pictured at the flocculator-clarifier with Millwright Robert Odle (left) and Utility Operator Richard Hunter (right).

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United States Steel